

**REMARKS**

Claims 1-20 were pending in this application.

Claims 1-4, 8-10, 14-16, and 20 have been rejected.

Claims 5-7, 11-13, and 17-19 have been objected to.

Claims 1-20 remain pending in this application.

Reconsideration and full allowance of Claims 1-20 are respectfully requested.

**I. ALLOWABLE CLAIMS**

The Applicants thank the Examiner for the indication that Claims 5-7, 11-13, and 17-19 would be allowable if rewritten in independent form to incorporate the elements of their respective base claims and any intervening claims. Because the Applicants believe that the remaining claims in this application are allowable, the Applicants have not rewritten Claims 5-7, 11-13, and 17-19 in independent form.

**II. REJECTION UNDER 35 U.S.C. § 103**

The Office Action rejects Claims 1-3, 8, 9, and 14-16 under 35 U.S.C. § 103(a) as being unpatentable over Prior Art of Present Invention (“*PAPI*”) in view of U.S. Patent No. 6,010,914 to Shishiguchi et al. (“*Shishiguchi*”). The Office Action rejects Claims 4 and 10 under 35 U.S.C. § 103(a) as being unpatentable over *PAPI* and *Shishiguchi* in further view of U.S. Patent No. 6,639,228 to Yen (“*Yen*”). The Office Action rejects Claim 20 under 35 U.S.C. § 103(a) as being unpatentable over *PAPI* and *Shishiguchi* in further view of U.S. Patent No. 6,277,657 to Nozawa et al. (“*Nozawa*”). These rejections are respectfully traversed.

In *ex parte* examination of patent applications, the Patent Office bears the burden of establishing a *prima facie* case of obviousness. (*MPEP* § 2142; *In re Fritch*, 972 F.2d 1260, 1262, 23 U.S.P.Q.2d 1780, 1783 (Fed. Cir. 1992)). The initial burden of establishing a *prima facie* basis to deny patentability to a claimed invention is always upon the Patent Office. (*MPEP* § 2142; *In re Oetiker*, 977 F.2d 1443, 1445, 24 U.S.P.Q.2d 1443, 1444 (Fed. Cir. 1992); *In re Piasecki*, 745 F.2d 1468, 1472, 223 U.S.P.Q. 785, 788 (Fed. Cir. 1984)). Only when a *prima facie* case of obviousness is established does the burden shift to the Applicant to produce evidence of nonobviousness. (*MPEP* § 2142; *In re Oetiker*, 977 F.2d 1443, 1445, 24 U.S.P.Q.2d 1443, 1444 (Fed. Cir. 1992); *In re Rijckaert*, 9 F.3d 1531, 1532, 28 U.S.P.Q.2d 1955, 1956 (Fed. Cir. 1993)). If the Patent Office does not produce a *prima facie* case of unpatentability, then without more the Applicant is entitled to grant of a patent. (*In re Oetiker*, 977 F.2d 1443, 1445, 24 U.S.P.Q.2d 1443, 1444 (Fed. Cir. 1992); *In re Grabiak*, 769 F.2d 729, 733, 226 U.S.P.Q. 870, 873 (Fed. Cir. 1985)).

A *prima facie* case of obviousness is established when the teachings of the prior art itself suggest the claimed subject matter to a person of ordinary skill in the art. (*In re Bell*, 991 F.2d 781, 783, 26 U.S.P.Q.2d 1529, 1531 (Fed. Cir. 1993)). To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to

make the claimed invention and the reasonable expectation of success must both be found in the prior art, and not based on the Applicant's disclosure. (*MPEP § 2142*).

Regarding Claim 1, the Office Action acknowledges that *PAPI* fails to disclose almost every element of Claim 1. In particular, the Office Action acknowledges that *PAPI* fails to disclose performing a "thermal oxidation procedure on said silicon germanium film to create a layer of thermal oxide over said silicon germanium film," "measuring a thickness of said layer of thermal oxide," and "providing a correlation that relates a thickness of a layer of thermal oxide created over a silicon germanium film to a germanium concentration of said silicon germanium film." (*Office Action, Page 4, Lines 1-5*). These items represent the first three steps in the method of the invention that is set forth in Claim 1.

What the Office Action did not say is that *PAPI* also fails to disclose the fourth step in the method that is set forth in Claim 1. That is, *PAPI* also fails to disclose the step of "determining said germanium concentration of said silicon germanium film by identifying a germanium concentration that corresponds to said measured thickness of said layer of thermal oxide in accordance with said correlation." (Emphasis added). There is nothing in *PAPI* concerning measurement of the thickness of a thermal oxide and correlating the value of the thickness of the thermal oxide to the germanium concentration of a silicon germanium film.

The Office Action stated that "However, Shishiguchi teaches that it is known in the art to provide apparatus and method comprising the steps of performing a thermal oxidation (figure 8A) procedure on said silicon germanium film (SiGe [40 of figure 3C]) to create a layer of thermal oxide over said silicon germanium film (figure 3C as indicated Si [31 of figure 3C], Silicon-oxide [39 of figure 3C], and SiGe [40 of figure 3C], measuring a thickness of said layer

of thermal oxide by detector (55 of figure 5) coupled to a thickness measurement system (56 of figure 5 and col. 4 lines 41-60); and providing a correlation that relates a thickness of a layer of thermal oxide created over a silicon germanium film by identifying a germanium concentration (col. 5 lines 38-65). See figures 1-9.” (*Office Action, Page 4, Lines 5-14*).

For the reasons set forth below, the Applicants respectfully traverse these assertions of the Examiner and respectfully submit that the Examiner has incorrectly interpreted the actual teaching of the *Shishiguchi* reference. Therefore, the Applicants also respectfully traverse the Examiner’s assertion that it would have been obvious to combine the teachings of *PAPI* and the teachings of the *Shishiguchi* reference.

As will be more fully described, the *Shishiguchi* reference does not mention the concept of measuring the thickness of a thermal oxide layer. The *Shishiguchi* reference also does not mention the concept of correlating the measured thickness of a thermal oxide layer to a germanium concentration of an underlying silicon germanium film.

*Shishiguchi* recites a method for manufacturing a semiconductor device in which visible light optical interference techniques are used to measure the thickness of a silicon layer, or a polysilicon layer, or a epitaxial silicon-germanium layer. The *Shishiguchi* reference is silent concerning a measurement of the thickness of a thermal oxide layer. Therefore, the *Shishiguchi* reference is also silent concerning the concept of using a measurement of the thickness of a thermal oxide layer to correlate to a germanium concentration in an underlying silicon germanium film.

Consider the first embodiment of the *Shishiguchi* device as described in Column 3 and as shown in Figure 3C. The bottom layer is a silicon substrate 31. The next layer (which

*Shishiguchi* calls the first layer 39) may be either silicon oxide or silicon nitride. Above the first layer 39 is the second layer 40. Second layer 40 comprises silicon (Si) or silicon germanium (SiGe). (*Column 3, Lines 41-42*). The top layer is a test pattern layer 41.

The *Shishiguchi* method measures the thickness of the second layer 40 by the optical interference method. *Shishiguchi* clearly states that “The thickness of the second layer 40 made of Si or  $\text{Si}_{1-x}\text{Ge}_x$  can be measured by using an optical interference within a visible light range.” (*Column 3, Lines 49-51*). The *Shishiguchi* method also measures the sum of the thickness of the test pattern layer 41 and the thickness of the second layer 40. “A sum of the thicknesses of the test pattern layer 41 and the second layer 40 (referred to as the total thickness, hereafter) can be measured by the optical interference method.” (*Column 3, Lines 62-64*). There is no mention of measuring the thickness of the silicon oxide layer 39.

Now consider the second embodiment of the *Shishiguchi* device as described in Column 4 and as shown in Figure 4C. The bottom layer is a silicon substrate 41. The next layer is a buried oxide layer 49. Above the buried oxide layer 49 is more of the silicon substrate 41. The top layer is an epitaxial layer 50 of silicon crystal or silicon germanium.

The *Shishiguchi* method measures the thickness of the epitaxial layer 50 by the optical interference method. *Shishiguchi* clearly states that “The thickness of the Si crystal layer 50 above the buried layer 49 can be measured by the optical interference.” (*Column 4, Lines 26-28*). “The present [*Shishiguchi*] invention can be directed to measurement of a thickness of an epitaxial  $\text{Si}_{1-x}\text{Ge}_x$  layer.” (*Column 4, Lines 38-40*). There is no mention of measuring the thickness of the buried oxide layer 49.

Now consider the Third Example of the second embodiment of the *Shishiguchi* device as described in Column 6 and as shown in Figure 7C. The buried oxide layer 73 is formed two hundred nanometers (200 nm) beneath the substrate surface. (*Column 6, Lines 12-13*) As before, only the thickness of the silicon epitaxial layer 78 is measured.

The claims of the *Shishiguchi* patent are only directed to methods that measure the thicknesses of the silicon layers. There are no claims that are directed to methods that measure the thickness of a silicon oxide layer.

From the foregoing analysis of the *Shishiguchi* patent, it is clear that the *Shishiguchi* patent is silent concerning a measurement of the thickness of a thermal oxide layer. Therefore, the *Shishiguchi* patent is also silent concerning the concept of using a measurement of the thickness of a thermal oxide layer to correlate to a germanium concentration in an underlying silicon germanium film.

The Office Action has failed to show that *PAPI* or the *Shishiguchi* patent discloses, teaches, or suggests determining a germanium concentration of a silicon germanium film “by identifying a germanium concentration that corresponds to said measured thickness of said layer of thermal oxide in accordance with said correlation.” *PAPI* lacks any mention of using any type of correlation that relates a measured thickness of a layer of thermal oxide to a germanium concentration in order to determine the germanium concentration of a silicon germanium film.

The *Shishiguchi* patent lacks any mention of using the measured thickness of a thermal oxide layer to determine the germanium concentration of a silicon germanium film. The *Shishiguchi* patent never recites that the thickness of a thermal oxide layer can be used

to determine the germanium concentration of a silicon germanium film based on a “correlation” of thermal oxide thickness to germanium concentration.

The Office Action asserts that *PAPI* discloses “determining said germanium concentration of said silicon germanium film by identifying a germanium concentration by an analyze results of SIMS method.” (*Office Action, Page 3, Lines 5-8*). However, Claim 1 recites determining the germanium concentration of a silicon germanium film “by identifying a germanium concentration that corresponds to said measured thickness of said layer of thermal oxide in accordance with said correlation.” The Office Action makes no attempt to show that the *Shishiguchi* patent discloses, teaches, or suggests determining a germanium concentration using a “measured thickness” of a “layer of thermal oxide” in accordance with a “correlation” that relates a thickness of the thermal oxide layer to the germanium concentration. This would be particularly difficult given that the *Shishiguchi* patent is silent concerning the measurement of a thickness of a thermal oxide layer.

The *Shishiguchi* patent fails to anticipate or suggest the elements in Claim 1. Claim 1 recites that the measured thickness of a thermal oxide layer created over a silicon germanium film is used to determine the germanium concentration of the silicon germanium film. In other words, the thickness of one layer (the thermal oxide layer) is used to determine the germanium concentration of a separate layer (the silicon germanium film). The *Shishiguchi* patent says absolutely nothing about using the thickness of one layer to determine the germanium concentration of a separate layer.

The Office Action cites absolutely nothing either in *PAPI* or in the *Shishiguchi* patent that shows that the measured thickness of a thermal oxide layer can be used, along with

a correlation of thermal oxide thickness to germanium concentration, to determine the germanium concentration of a silicon germanium film.

For these reasons, the Office Action does not establish a *prima facie* case of obviousness against Claim 1 (and its dependent claims).

Claim 9 recites “measuring a thickness of each of said layers of thermal oxide” and “correlating said thickness of each of said layers of thermal oxide with a corresponding value of germanium concentration.” As noted above, both *PAPI* and the *Shishiguchi* patent fail to disclose, teach, or suggest correlating a thickness of a thermal oxide layer with a germanium concentration.

For these reasons, the Office Action does not establish a *prima facie* case of obviousness against Claim 9 (and its dependent claims).

Claim 14 recites “measuring a thickness of said layer of thermal oxide in real time,” “providing a correlation that relates a thickness of a layer of thermal oxide created over a silicon germanium film to a germanium concentration of said silicon germanium film,” and “determining said germanium concentration of said silicon germanium film in real time by identifying a germanium concentration that corresponds to said measured thickness of said layer of thermal oxide in accordance with said correlation.” As noted above, both *PAPI* and the *Shishiguchi* patent fail to disclose, teach, or suggest using a correlation of thermal oxide layer thickness to germanium concentration in order to determine the “germanium concentration” of a “silicon germanium film.”

For these reasons, the Office Action does not establish a *prima facie* case of obviousness against Claim 14 (and its dependent claims).

The Office Action also rejected Claim 4 and 10 under 35 U.S.C. § 103(a) as being unpatentable over *PAPI* in view of *Shishiguchi* and further in view of *Yen*. The Applicants herein repeat and incorporate by reference all of the remarks and arguments previously made with respect to *PAPI* and the *Shishiguchi* patent. The Applicants respectfully submit that the *Yen* patent does not and can not supply the deficiencies of *PAPI* and the *Shishiguchi* patent. Therefore, the Applicants respectfully submit that Claim 4 and 10 are allowable in view of *PAPI* and the *Shishiguchi* patent and the *Yen* patent.

The Office Action also rejected Claim 20 under 35 U.S.C. § 103(a) as being unpatentable over *PAPI* in view of *Shishiguchi* and further in view of *Nozawa*. The Applicants herein repeat and incorporate by reference all of the remarks and arguments previously made with respect to *PAPI* and the *Shishiguchi* patent. The Applicants respectfully submit that the *Nozawa* patent does not and can not supply the deficiencies of *PAPI* and the *Shishiguchi* patent. Therefore, the Applicants respectfully submit that Claim 20 is allowable in view of *PAPI* and the *Shishiguchi* patent and the *Nozawa* patent.

Accordingly, the Applicants respectfully request withdrawal of the § 103 rejections and full allowance of Claims 1-4, 8-10, 14-16, and 20.

### III. CONCLUSION

The Applicants respectfully assert that all pending claims in this application are in condition for allowance and respectfully request full allowance of the claims.

**SUMMARY**

If any issues arise, or if the Examiner has any suggestions for expediting allowance of this application, the Applicants respectfully invite the Examiner to contact the undersigned at the telephone number indicated below or at [wmunck@munckbutrus.com](mailto:wmunck@munckbutrus.com).

The Commissioner is hereby authorized to charge any fees connected with this communication (including any extension of time fees) or credit any overpayment to Deposit Account No. 50-0208.

Respectfully submitted,

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